Stat 217 Review Solutions

1. (a) Ho:$\mu$ = 1100
   Ha: $\mu$ < 1100
   (b) RHo if Zcalc <-1.645 (you can use Z because df=259)
   (c) Zcalc = -2.69
   Dec: RHo, -2.69<-1.645
   Conclusion: At the 5% significance level, there's a drop in the average daily production.
   (d) P-value = P(z<-2.69) = .0036
   (e) P(z<-2.24) = .0125 the significance level is $\alpha$=.0125 Since 1040<1050, then we RHo and conclude that there's a drop in the average daily production.

2. (a) (i) Ho:$\mu_d$ = 0
   Ha: $\mu_d$ > 0 (B – A)
   RHo if tcalc >2.447 (df = 6, $\alpha$ = .025)
   tcalc = 3.4382 ( $\bar{d}$ = 3.8571, $s_d$ = 2.9681
   Dec: RHo, 3.4382>2.447
   Conclusion: At the 2.5% significance level, OSHA has been effective in reducing lost time accidents
   Note: you could have done a left tailed test, then you would make all the values negative.
   (ii) P-value = P(t >3.4382 ) = .0064 (computer)
   0.005< p-value < 0.01 (tables)
   (b) Wilcoxon Signed-Rank test
   Ho:the distributions are the same for accidents before and after OSHA
   Ha: There are more accidents before OSHA than after
   W+ = 26.5 W- =1.5 (B-A)
   RHo is W $\leq$2
   Dec: RHo , 1.5<2
   Conclusion: At the 2.5% significance level, same as above

3. (a) Ho: January indicator is independent of market prices the rest of the year
   Ha: January indicator is not independent of market prices the rest of the year (it can be used to predict the market prices for the rest of the year)
   RHo is $\chi^2$calc >3.841 (df = 1, $\alpha$ = .05)
   $\chi^2$calc =3.381
   Dec: Fail to RHo 3.381<3.841
   Conclusion: At the 5% significance level, January indicator is independent of market prices for the rest of the year. It can not be used to predict the market prices for the rest of the year.

   Could also do a two population proportions test.

Rho if |zcalc| >1.96, p^pooled = .6389, P^1 = 33/46 = .7174, p^2 = 13/36 = .5,
Z calc = 1.8447

Dec: Fail to Rho 1.8447<1.96 and >-1.96.
Conclusion: same as above.

(b) p-value = $P(\chi^2 > 3.381)$ = .0660 (computer)
05< p-value <.10 (tables)
or Proportions: P-value = 2×P(z>1.8447) = .065

4. $n_s = n_c = n$, $z_{\alpha/2} = 1.96$, error = 1 $\sigma_s^2 = \sigma_c^2 = 9$

$$error = z_{\alpha/2}\sqrt{\frac{\sigma_s^{\ 2}}{n_s}+\frac{\sigma_c^{\ 2}}{n_c}} \quad 1 = 1.96\sqrt{\frac{9}{n}+\frac{9}{n}}$$

n = 69.1488 ~ 70

5. Ho: All choices are equally likely
Ha: Not all choices are equally likely
RHo is $\chi^2$calc >9.48773 (df = 4, α = .05)
$\chi^2$calc =8.857
Dec: Fail to RHo, 8.857<9.48773
Conclusion: At the 5% significance level, there is no indication that all answers are not equally likely.

6. a. Ho:μ=3.2
Ha:μ≠3.2
Rho if tcalc>2.306, or <2.306
Tcalc = 2.8535
Dec: Rho 2.8535>2.306
Conclusion: At the 5% sig. level, the sample data does not support their belief of 3.2.
b. 2.742 or 3.658
c. First test the variances
Ho: $\sigma_3 = \sigma_2$
Ha: $\sigma_3 \neq \sigma_2$
Rho if Fcalc >4.43 or < .2257
Fcalc = 3.1345 (or .3190 if $\sigma_3$ *and* $\sigma_2$ were reversed in Ho and Ha)
Dec: Fail to RHo 3.3145 <4.43 and >.2257
Conc: At the 5% significance level, the variances are the same.

**Assumptions : equal population variances ( F-test showed this above)**
**Independent random samples ( 9 were randomly assigned to design 2 and 9 were randomly assigned to design 3)**
**Normal populations (it says to assume this)**

Ho: $\mu_2 = \mu_3$
Ha: $\mu_2 \neq \mu_3$
Rho if tcal >2.12 or <-2.12
Sp=.544 tcalc = -2.076
Dec: Fail to Rho -2.076>-2.12 and <2.12

Conc: At the 5% significance level, there appears to be no significant difference between design 2 and 3 with respect to wear.

d. **1 way ANOVA**

| Source | SS | DF | MS | F |
|---|---|---|---|---|
| Treatment | 6.2607 | 2 | 3.1.037 | 9.886 |
| Error | 7.5911 | 24 | 0.31629 | |
| Total | 13.8518 | 26 | | |

Ho: Designs are the same with regard to wear
Ha: Designs are not the same with regard to wear
Rho if Fcalc > 3.40 (df= 2,24 $\alpha$ = .05) (one-way ANOVA)
Fcalc = 9.886
Dec: RHo, 9.886>3.4
Conclusion: at the 5% significance level, not all designs have the same wear.
Assume normal populations, independent random samples, equal population variances.

(b) a. Ho:median =3.2
Ha:median ≠3.2
N=8 T+=33 T-=3 T=3
Rho if T ≤4
Dec: Rho 3<4
Conc: At the 5% significance level, the median is not 3.2

c. Ho: Design 2 is the same as design 3
Ha: Design 2 is not the same as design 3
T1=65 (design 2) T2=106 (design 3) n1=9, n2=9 Rho is T≤63 or ≥108
T = 65 (or 106 since sample sizes are the same)
Dec Fail to Rho 65>63 and <108
Conc: At the 5% significance level, there is no significant difference in design 2 and 3 with respect to wear.

d. Ho: all 3 designs have the same wear
Ha: not all designs have the same wear
Rho if the test statistic >5.99147

$$KW = \frac{12}{27(28)}\left(\frac{68^2}{9}+\frac{129.5^2}{9}+\frac{180.5^2}{9}\right)-3(28)=11.1931$$

Dec: Rho 11.1931>5.99147
Concl: At the 5% significance level, not all designs have the same wear.

7.

| Parameter | Value | St.Dev | T-ratio |
|---|---|---|---|
| Intercept | 2.368421 | 2.070594 | 1.143837 |
| Slope | 1.002193 | 0.137856 | **7.269860** |

S=**1.316506 ( $\sqrt{MSE}$ )** Rsquared= **0.946286 (SSR/SST)**

**ANOVA TABLE**

Source DF SS MS F

| | | | | |
|---|---|---|---|---|
| Regression | **1** | **91.600439** | 91.600439 | **52.850865** |
| Residual | **3** | **5.199561** | **1.733187** | |
| Total | **4** | **96.800** | | |

(b) $\hat{y} = 2.368421 + 1.002193(x)$

(c) s = 1.316506

(d) Ho:$\beta_1 = 0$
Ha: $\beta_1 \neq 0$
RHo if tcalc< -3.182 or >3.182 (df =3, $\alpha$ = .05)
Tcalc = 1.002193-0 /0.1379856 = 7.27
Dec: RHo, 7.27>3.182
Conclusion: At the 5% significance level, there is a linear association between sales and test score

(e) Ho:$\beta_1 = 0$
Ha: $\beta_1 \neq 0$
RHo if Fcalc >10.12 (df =1,3 $\alpha$ = .05)
Fcalc = 52.851 (~ $7.27^2$ = $tcalc^2$)
Dec: RHo, 52.851>10.12
Conclusion: At the 5% significance level, there is a linear association between sales and test score

(f) $r^2$ = .946286(coefficient of determination), r = .9728 94.63% of the variability in y is explained by the regression model. This is quite high.
Since r is close to 1, there is a strong positive linear association between test score and sales.

(g) $\hat{y} \pm t_{\alpha/2} S\sqrt{\frac{1}{n} + \frac{(x^* - \bar{x})^2}{Sxx}}$ $17.4 \pm 5.841(1.3165)\sqrt{\frac{1}{5} + \frac{(15-14.4)^2}{91.2}}$

17.4 ± 3.47 (13.93, 20.87) in $1000

(h) $\hat{y} \pm t_{\alpha/2} S\sqrt{\frac{1}{n} + 1 + \frac{(x^* - \bar{x})^2}{Sxx}}$ $17.4 \pm 5.841(1.3165)\sqrt{\frac{1}{5} + 1 + \frac{(15-14.4)^2}{91.2}}$

17.4 ± 8.44 (8.96, 25.84) in $1000

8. Paired data
Wilcoxon Signed-Rank test
Ho:the distributions are the same for dinner spending
Ha: the distributions are not the same for dinner spending
W+ = 23 W- = 5 (man- woomean) W = 5
RHo if W $\leq$ 2
Dec: Fail to RHo, 5 >2
Conclusion: At the 5% significance level, there appears to be no significant difference in spending for the males and females.

9. Kruskall Wallis test

Ho: the distributions are the same for the 3 stores
Ha: distributions are not all the same for the 3 stores.

Rho if KW > 5.991 ($\chi^2$.05, 2)

$$KW = \frac{12}{15(16)}\left(\frac{19.5^2}{5} + \frac{40.5^2}{5} + \frac{60^2}{5}\right) - 3(16) = 8.205$$

Dec: RHo, 8.205>5.991
Conclusion: At the 5% significance level, there appears to be a significant difference in spending for the 3 stores..

10. (a) (i) Ho: $\mu \leq 1.5$
Ha: $\mu > 1.5$

$$Z = \frac{1.91 - 1.5}{2/\sqrt{100}} = 2.05 \quad P(z>2.05) = 0.0202$$

(ii) $$Z = \frac{1.91 - 1.7}{2/\sqrt{100}} = 1.05 \quad P(z<1.05) = 0.8531$$

(b)(i) $$n = \left(\frac{2.326(2)}{.233}\right)^2 = 398.6 \sim 399$$

(ii) $1.76 \pm 0.233$ (1.527, 1.993)
The CI is above 1.5 indicating that the advertisement is not true

11. (a) Ho: $p \leq .5$
Ha: $p > .5$

(b) (i) $$1.645 = \frac{\hat{p} - .5}{\sqrt{(.5)(.5)/400}} \quad \hat{p} = .541125$$

$\hat{p} = x/n \quad \hat{p}n = x \quad$ x = 400(.54125) = 216.45 ~217

(ii) z calc = 1 P(z>1) = .1587

12. (a) (i)Ho: $\mu_s \leq \mu_n$
Ha: $\mu_s > \mu_n$

RHo if tcalc > 2.821 (df =9, $\alpha$ = .01
$s_p^2$ = 5.2775
tcalc = 10.42
Dec: RHo, 10.42>2.821
Conclusion: At the 1% significance, the corrosion is less for the new paint

(ii)Ho: $\mu_s \leq \mu_n$
Ha: $\mu_s > \mu_n$

RHo if tcalc > 3.365 (df =5, $\alpha$ = .01)
tcalc = 9.739
Dec: RHo 9.739>3.365

Conclusion: At the 1% significance, the corrosion is less for the new paint

(b) Ho: The corrosion is the same for both paints
Ha: The corrosion is higher for the old paint
RHo if $M \geq 40$ n1=5, n2=6 $\alpha = .05$
M= 45
Dec: RHo, 45>40
Conclusion: Same as before

13. (a) Ho: $\mu \leq 3$
Ha: $\mu > 3$
RHo if tcalc> 2.463 (df = 29, $\alpha = .01$)
tcalc = 5.921
Dec: RHo, 5.912>2.463
Conclusion: At the 1% significance, the response time exceeds 3 seconds on average
(b) p-value = P(t>5.921) = 0 (computer)
p-value<.005 (tables)
(c) Ho: $\sigma \geq .5$
Ha: $\sigma < .5$
RHo if $\chi^2$calc<17.7083 (df = 29, $\alpha = .05$)
$\chi^2$calc = 15.8804
Dec: RHo, 15.8804<17.7083
Conclusion: At the 5% significance, the standard deviation is lower than 0.5
(d) p-value= P($\chi^2$> 15.8804) = .0231 (computer)
.01< p-value< .025

14. (a) $(.547 - .252) \pm 1.96\sqrt{\dfrac{.547(.453)}{100} + \dfrac{.252(.748)}{100}}$ .295± .129 (.166, .424)
(b) Since zero does not fall in the 95% CI, this indicates that the % in 1982 is greater than the percentage now.
(c) Ho: p82≤pnow
Ha: p82> pnow

15.

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Trt | 45.6 | **2** | **22.8** | **6** |
| Block | **60** | **4** | 15 | **3.947** |
| error | **30.4** | **8** | **3.78** | |

(test of blocks)
Ho: no difference between times
Ha: Mean weights not the same for all times

Rho is Fblock> 3.838 (df = 4,8, $\alpha = .05$)
Fblock = 3.947
Dec:RHo, 3.947>3.838

Conclusion: At the 5% significance level, mean weights are not the same for all times.

(test of treatments)
Ho: no difference between the processes
Ha: not all processes are the same

Rho if Ftrt> 4.459 (df = 2,8, $\alpha = .05$)
Ftrt = 6
Dec:RHo, 6>4.459
Conclusion: At the 5% significance level, not all processes are the same.

16. Ho:$\mu \leq 15$
Ha: $\mu > 15$
Zcalc = 3.426
p-value = P(z> 3.426) = .0003
Since p-value is small, we RHo and conclude that the advertisement is most likely false.

17. Ho:$\sigma \leq .95$
Ha; $\sigma > .95$
RHo if $\chi^2$calc>18.307 (df = 10, $\alpha = .05$)
$\chi^2$calc = 17.871
Dec: Fail to RHo
Conclusion: At the 5% significance, the standard deviation is not greater than 0.95

18. (a) Ho:$\mu \leq 100{,}000$
Ha: $\mu > 100{,}000$
RHo if tcalc > 1.753 (df = 15, $\alpha = .05$)
tcalc = 1.867
Dec:RHo
Conclusion: At the 5% significance level, the firm's claim is false ( $\mu >$ \$100,000)

(b) p-value = P(t>1.867) = .0408 (computer)
.025 < p-value < .05 (tables)

19. (a) Test for equal population variances.
Ho: $\sigma^2{}_1 = \sigma^2{}_2$
Ha: $\sigma^2{}_1 \neq \sigma^2{}_2$
RHo if Fcalc > 1.61 (using 40 and 120 df because the table can't read 49 and 99 df)
Or Fcalc > 1.74 (using 40 and 60 df because the table can't read 49 and 99 df)
Fcalc = $1.6^2/.8^2 = 4$
Dec RHo
Conc: At the 5% significance level, the variances are not the same.

We do a non-pooled confidence interval
Df = 61 t~2 (since it's close to 10 df) or we could use z = 1.96 since the sample size is large.

Using z:

$$(4.6 \pm 1.96\sqrt{\frac{.8^2}{100}+\frac{1.6^2}{50}} \qquad 4.6 \pm .47 \ (4.13, 5.07)$$

$$4.6 \pm 2\sqrt{\frac{.8^2}{100}+\frac{1.6^2}{50}} \qquad 4.6 \pm .48 \ (4.12, 5.08)$$

(b) Yes there is a difference because the CI does not include zero. The mean days for female is anywhere from 4.13 to 5.07 or (4.12 to 5.08) more than males.

20. (a)(i) Ho: $\mu \geq 507.5$
Ha: $\mu < 507.5$
(ii) tcalc = -2.012
(iii) p-value = P(t< -2.012) = .0395 (computer)
.025< p-value < .05 (tables)
Since p-value is small, the shop machine should be adjusted.

(b) Wilcoxon Signed Rank test
Ho: The machine is working fine
Ha: The machine is not working fine (median <507.5)
RHo if W≤8 (n= 9 $\alpha$ = .05)
W+ = 8.5 W- = 36.5 W = 8.5
Dec: Fail to RHo, 8.5>8
Conclusion: At the 5% significance level, it appears that the machine should **no**t be adjusted.

Sign test S+=3 S-=6

P-value = P(X≥6) = $9C6(.5)^6(.5)^3 + 9C7(.5)^7(.5)^2 + 9C8(.5)^8(.5)^1 + 9C9(.5)^9(.5)^0$
=.2539

or

P(X≤3) = $9C3(.5)^3(.5)^6 + 9C2(.5)^2(.5)^7 + 9C1(.5)^1(.5)^8 + 9C0(.5)^0(.5)^9$
=.2539

Dec: Fail to RHo .2539>.05